

What Is Claimed Is:

1 1. A method for verifying whether a trace can be produced by a
2 generator, comprising:
3 receiving a specification for the generator, wherein the generator is a finite
4 state machine that defines a set of inputs and outputs, and wherein the generator may
5 contain parametric inputs to model non-determinism;
6 receiving the trace, wherein the trace is a sequence of assignments of non-
7 parametric inputs and outputs for the generator, and wherein the trace does not
8 contain assignments of parametric inputs;
9 using the specification to build a data structure that can be used to determine
10 if a non-parametric input and output are consistent with the current state of the
11 generator; and
12 verifying elements of the trace, wherein verifying a given element involves
13 using the data structure to determine if there exists any parametric input assignment
14 that causes a match between non-parametric inputs and outputs of the generator with
15 the ones specified in the given element of the trace.

1 2. The method of claim 1,
2 wherein the generator is sequentially deterministic, which means that there
3 exists a single next state for each combination of current state, non-parametric input,
4 and output; and
5 wherein using the data structure to determine if there exists any parametric
6 input assignment involves,
7 using the data structure to perform a satisfiability test to
8 determine if there exist any parametric inputs that can match the non-

9 parametric input and output assignment of the generator with the ones
10 of the trace at a current state, and
11 computing a unique next state based on the current state, the
12 non-parametric input and the output.

1 3. The method of claim 1,
2 wherein the generator is sequentially non-deterministic, which means that the
3 next state can depend on a parametric input, and consequently there can exist more
4 than one next state for some combinations of current state, non-parametric input, and
5 output; and
6 wherein using the data structure to determine if there exists any parametric
7 input assignment involves determining a set of next states;
8 wherein determining the set of next states involves considering all possible
9 parametric inputs, all states in a current set of states, the non-parametric input and the
10 output;
11 wherein if there exists at least one state in the set of next states, the non-
12 parametric input and output are consistent with the generator.

1 4. The method of claim 3, wherein determining the set of next states
2 involves computing a forward image and constraining the parametric input and
3 output to their assignments in the trace.

1 5. The method of claim 1, wherein the trace is produced by a simulation
2 of a system under test.

1 6. The method of claim 1, wherein the data structure is in the form of a
2 binary decision diagram (BDD).

1 7. The method of claim 1, wherein if for all possible parametric inputs
2 the non-parametric input and output are not consistent with a generator output, the
3 trace is not valid.

1 8. The method of claim 1, wherein if the specification of the generator is
2 sequentially deterministic, and hence does not depend on parametric inputs, the
3 method further comprises translating the generator into a checker and using that
4 checker to verify the trace.

1 9. A computer-readable storage medium storing instructions that when
2 executed by a computer cause the computer to perform method for verifying whether
3 a trace can be produced by a generator, comprising:

4 receiving a specification for the generator, wherein the generator is a finite
5 state machine that defines a set of inputs and outputs, and wherein the generator may
6 contain parametric inputs to model non-determinism;

7 receiving the trace, wherein the trace is a sequence of assignments of non-
8 parametric inputs and outputs for the generator, and wherein the trace does not
9 contain assignments of parametric inputs;

10 using the specification to build a data structure that can be used to determine
11 if a non-parametric input and output are consistent with a parametric input and output
12 for the generator; and

13 verifying elements of the trace, wherein verifying a given element involves
14 using the data structure to determine if there exists any parametric input assignment

15 that causes a match between non-parametric inputs and outputs of the generator with
16 the ones specified in the given element of the trace.

1 10. The computer-readable storage medium of claim 9,
2 wherein the generator is sequentially deterministic, which means that there
3 exists a single next state for each combination of current state, non-parametric input,
4 and output; and
5 wherein using the data structure to determine if there exists any parametric
6 input assignment involves,
7 using the data structure to perform a satisfiability test to
8 determine if there exist any parametric inputs that can match the non-
9 parametric input and output assignment of the generator with the ones
10 of the trace at a current state, and
11 computing a unique next state based on the current state, the
12 non-parametric input and the output.

1 11. The computer-readable storage medium of claim 9,
2 wherein the generator is sequentially non-deterministic, which means that the
3 next state can depend on a parametric input, and consequently there can exist more
4 than one next state for some combinations of current state, non-parametric input, and
5 output; and
6 wherein using the data structure to determine if there exists any parametric
7 input assignment involves determining a set of next states of a generator;
8 wherein determining the set of next states involves considering all possible
9 parametric inputs, all states in a current set of states, the non-parametric input and the
10 output;

11 wherein if there exists at least one state in the set of next states, the non-
12 parametric input and output are consistent with the generator.

1 12. The computer-readable storage medium of claim 11, wherein
2 determining the set of next states involves computing a forward image and
3 constraining the parametric input and output to their assignments in the trace.

1 13. The computer-readable storage medium of claim 9, wherein the
2 trace is produced by a simulation of a system under test.

1 14. The computer-readable storage medium of claim 9, wherein the data
2 structure is in the form of a binary decision diagram (BDD).

1 15. The computer-readable storage medium of claim 9, wherein if for all
2 possible parametric inputs the non-parametric input and output are not consistent
3 with a generator output, the trace is not valid.

1 16. The computer-readable storage medium of claim 9, wherein if the
2 specification of the generator is sequentially deterministic, and hence does not
3 depend on parametric inputs, the method further comprises translating the generator
4 into a checker and using that checker to verify the trace.

1 17. An apparatus that verifies whether a trace can be produced by a
2 generator, comprising:

3 a receiving mechanism configured to receive a specification for the generator,
4 wherein the generator is a finite state machine that defines a set of inputs and outputs,
5 and wherein the generator may contain parametric inputs to model non-determinism;
6 wherein the receiving mechanism is additionally configured to receive the
7 trace, wherein the trace is a sequence of assignments of non-parametric inputs and
8 outputs for the generator, and wherein the trace does not contain assignments of
9 parametric inputs;
10 a data structure building mechanism configured to use the specification to
11 build a data structure that can be used to determine if a non-parametric input and
12 output are consistent with a parametric input and output for the generator; and
13 a verification mechanism configured to verify elements of the trace, wherein
14 verifying a given element involves using the data structure to determine if there exists
15 any parametric input assignment that causes a match between non-parametric inputs
16 and outputs of the generator with the ones specified in the given element of the trace.

1 18. The apparatus of claim 17,
2 wherein the generator is sequentially deterministic, which means that there
3 exists a single next state for each combination of current state, non-parametric input,
4 and output; and
5 wherein while using the data structure to determine if there exists any
6 parametric input assignment, the verification mechanism is configured to,
7 use the data structure to perform a satisfiability test to
8 determine if there exist any parametric inputs that can match the non-
9 parametric input and output assignment of the generator with the ones
10 of the trace at a current state, and to

11 compute a unique next state based on the current state, the
12 non-parametric input and the output.

1 19. The apparatus of claim 17,
2 wherein the generator is sequentially non-deterministic, which means that the
3 next state can depend on a parametric input, and consequently there can exist more
4 than one next state for some combinations of current state, non-parametric input, and
5 output; and

6 wherein while using the data structure to determine if there exists any
7 parametric input assignment, the verification mechanism is configured to determine a
8 set of next states of a generator;

9 wherein determining the set of next states involves considering all possible
10 parametric inputs, all states in a current set of states, the non-parametric input and the
11 output;

12 wherein if there exists at least one state in the set of next states, the non-
13 parametric input and output are consistent with the generator.

1 20. The apparatus of claim 19, wherein while determining the set of next
2 states the verification mechanism is configured to compute a forward image and
3 constraining the parametric input and output to their assignments in the trace.

1 21. The apparatus of claim 17, wherein the trace is produced by a
2 simulation of a system under test.

1 22. The apparatus of claim 17, wherein the data structure is in the form of
2 a binary decision diagram (BDD).

1 23. The apparatus of claim 17, wherein if for all possible parametric
2 inputs the non-parametric input and output are not consistent with a generator output,
3 the trace is not valid.

1 24. The apparatus of claim 17, wherein if the specification of the
2 generator is sequentially deterministic, and hence does not depend on parametric
3 inputs, the verification mechanism is configured to translate the generator into a
4 checker and use that checker to verify the trace.

1 25. A means for verifying whether a trace can be produced by a generator,
2 comprising:

3 a receiving means for receiving a specification for the generator, wherein the
4 generator is a finite state machine that defines a set of inputs and outputs, and
5 wherein the generator may contain parametric inputs to model non-determinism;

6 wherein the receiving means is additionally configured to receive the trace,
7 wherein the trace is a sequence of assignments of non-parametric inputs and outputs
8 for the generator, and wherein the trace does not contain assignments of parametric
9 inputs;

10 a data structure building means configured to use the specification to build a
11 data structure that can be used to determine if a non-parametric input and output are
12 consistent with a parametric input and output for the generator; and

13 a verification means configured to verify elements of the trace, wherein
14 verifying a given element involves using the data structure to determine if there exists
15 any parametric input assignment that causes a match between non-parametric inputs
16 and outputs of the generator with the ones specified in the given element of the trace.